

Real-Time Pedal-Operated System for Battery Charging

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ABSTRACT

Many rural residents of India get around on bicycles instead of cars. The majority of these settlements do not have access to even the most basic conveniences of modern life, such as electricity. Pedalling a bicycle can be used to generate mechanical energy, which can then be converted into electrical energy with the assistance of a dynamo or an alternator. Students who have access to a small lighting device that is charged by a dynamo are able to study even after the sun has set. This concept may find application in the field of supplying power to a variety of electronic devices, such as mobile phones, iPods, laptops, and other electronic devices that are functionally analogous to these. Vehicles that use alternators, like motorcycles and cars, have the ability to generate power from their wheels, which can then be used immediately or stored in a battery for later use. It has been demonstrated that the act of cycling can improve one's physical health and that it can also be used to generate useful energy. In this article, we discuss a process that generates electricity from the motion of pedalling a bicycle.

Keywords: Bicycles; E-vehicles; Power; Pedal operated systems.

1. Introduction

The entirety of the universe can be perceived as a vast reservoir of stored energy. It is a widely accepted fact that while energy cannot be generated or annihilated, it has the ability to undergo conversion into alternative forms [1]. However, there is a persistent trend of discarding potentially useful materials for electricity generation without regard for their finite availability. The current foremost concern of the global community pertains to the insufficiency of accessible energy. Consequently, it would be advantageous for all parties involved to explore methods of recuperating and repurposing the energy that would otherwise go to waste [2].

During the act of cycling, an individual is capable of generating approximately 150 watts of power. Nevertheless, this particular capacity proves to be futile as it is never utilised. If harnessed, this energy source has the potential to power a wide range of electronic devices [3]. The Earth possesses a diverse array of energies and potential sources of energy. The sustenance of a contemporary society necessitates a consistent provision of energy, thereby rendering dependable power grids of utmost importance. The significance of electrical energy is paramount in contemporary society in the 21st century. Electricity is a crucial component of daily life due to its extensive utilisation as a primary energy source [4]. Despite the significant potential of the power sector in India, it is currently facing challenges and falling short of its intended goals. In India, a considerable proportion of rural households lack access to electricity, with an estimated 600,000 villages in the country [5].

Power outages are a common occurrence for individuals residing in urban areas during contemporary times, which can be attributed to either technical malfunctions or a scarcity of energy resources [6]. The utilisation of pedal-powered generators has garnered significant attention among individuals in various scenarios where no feasible substitute to power generation based on fossil fuels is present. The concept of utilising pedal power has been in existence for a considerable period, however, it has not yet gained significant traction [7].

The pedal-powered generator is a mechanism that transforms human energy into electrical energy, which is then utilised for the purpose of charging storage batteries. In this particular context, the device responsible for producing electrical energy is commonly referred to as an alternator [8]. The mechanism responsible for generating electrical power in a bicycle is an alternator that is actuated by a belt and chain sprocket system affixed to the frame, which in turn rotates a pulley [9]. The pedal serves as the recipient of the input power, which subsequently leads to the attainment of the maximum rotational speed of the alternator rotor [10]. The goal of this project is to develop a certain type of autonomously reciprocating pedal-powered electrical generator (ARPPEG) along with the management and control of kinetic energy harvesting, electricity generation, storage, and output [11]. The effectiveness of this system in generating power has been demonstrated by the results of the operation tests. The implementation of ARPPEG created by us could pave a new path to energy conservation and aid in the development of a new energy society due to the system's straightforward design and inexpensive costs [12], which are not restricted by space or time.

2. Challenge and Limitations of Existing Systems

In a number of locations where the use of other methods to generate electricity is not a viable option, people have begun to show interest in pedal-powered generators. Even though the idea of harnessing the power of pedalling is not a new one [13], there have only been a few isolated instances of it being successfully put into practise [14]. In the more remote parts of India, there are a large number of schools that are of a residential nature but are not connected to the national power grid [15]. For these kinds of schools, a pedal power generator with a lighting system was created and put to the test. For every ten minutes of pedalling, it provides lighting for forty minutes [16]. Approximately 10 of these lighting systems are currently in use throughout India, and more are being shipped. The machine was created using an entirely unique method. Field testing of the device was carried out by end users rather than "engineers" or "scientists," as it was created and made by the manufacturing facility itself [17].



The machine was constructed using just locally accessible components, and it was continually tested with real customers. We looked into a wide range of lighting options for the classrooms. The requirements were rather straightforward. The only essential need was lights. We took into consideration solar photovoltaic, liquid petroleum gas-fired mantle lights, pressure kerosene lamps, etc [18]. The photovoltaic system would have been ideal, but it is

too pricey for an Indian common school. As a result, we made the decision to create a pedal-powered generator for battery charging. Although not a new idea, pedal power is not commonly used. The primary concept was to pedal at a pace that felt good while still producing enough power to be useful. We believed that a cycling time to lighting time ratio of 1:3 to 1:5 would be motivating enough to adopt this method of lighting.

3. Proposed System

Eco-friendly power from the energy storage system is utilised to power domestic appliances, industrial machinery, ships, and boats with this "PEDAL POWER OPERATED SYSTEM FOR BATTERY CHARGING". This cleans up the environment. Nothing is emitted from it. People who want to charge their batteries without relying on an electrical outlet or other external power sources may find that a real-time pedal-operated system is the perfect solution.

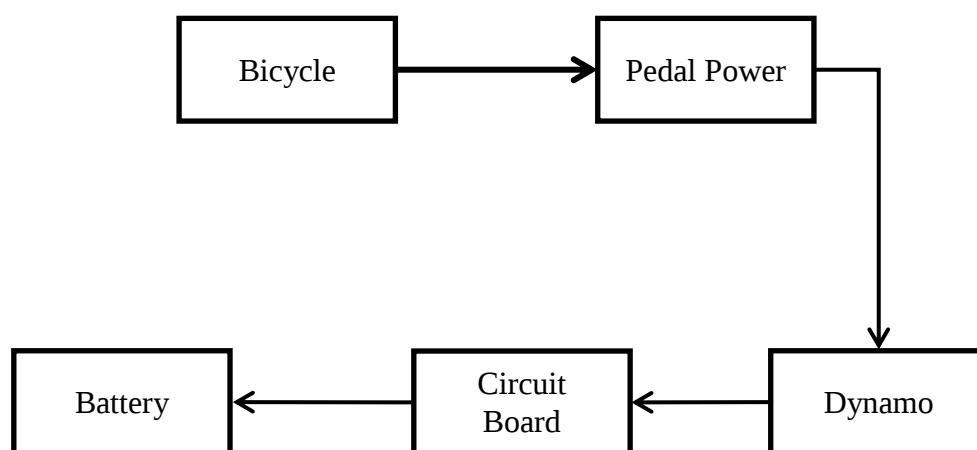


Figure 1. Block diagram of proposed system

The system could be made in the following way:

3.1. Generator with pedal power

A pedal-powered device can be connected to a generator, which will produce electricity when the pedals are turned. To store the generated electricity, this generator can be connected to a battery.

3.2. Battery

The battery will serve as a storage device for the power produced by the generator. A rechargeable battery that can power a variety of gadgets could serve as the battery. Charge controller: A charge controller will control the battery's charging and make sure it isn't overcharged. The charge controller can be configured to optimise charging speed and guard against battery deterioration. Display: The system may be upgraded to include a display that indicates the battery's level of charge and the amount of electricity produced.

3.3. Pedal mechanism

The user-friendly and comfortable pedal mechanism can be designed. The pedals can be adjusted to accommodate various user heights and offer the required amount of resistance to produce electricity. The system can be contained in a small, transportable case, which makes it simple to move about and store. Batteries for many different gadgets,

including cameras, laptops, and cellphones, can be charged with this pedal-operated real-time system. For folks who are camping, trekking, or travelling in locations without many electrical outlets, it can be a great alternate power source. Bicycle power generating is suggested in this project. Energy is produced by pedalling the bicycle and is then saved in the battery. As the current generated in the DC form can be stored directly in the battery, it is employed to store electricity. The DC motor charges and maintains the battery's charge. The battery stores the energy that is produced for use at night. When it gets dark out, the LDR's resistance rises and turns on the light. The output of the LDR sensor is used to control the DC motor using the Arduino Uno board. In addition to helping you lose weight, your pedal-powered cardiovascular activity contributes to a heart-healthy lifestyle. Cycling makes your heart beat faster and improves the flow of oxygen via your blood vessels. Don't push yourself too hard too quickly, though, if you're just beginning out more cost-effective than gasoline-powered automobiles and motorcycles and less expensive than purchasing an urban electric vehicle. You don't need to purchase a new bike because you can modify your conventional bike using a kit and do it yourself in a few minutes. Pedal power is a sustainable and renewable source of energy because it doesn't require any outside fuel or electricity. It is an environmentally friendly means of generating power. Pedal-operated chargers are extremely portable and may be used anywhere, including remote areas without access to electricity. For outdoor activities like riding, hiking, and camping, they are ideal.

4. Methodology

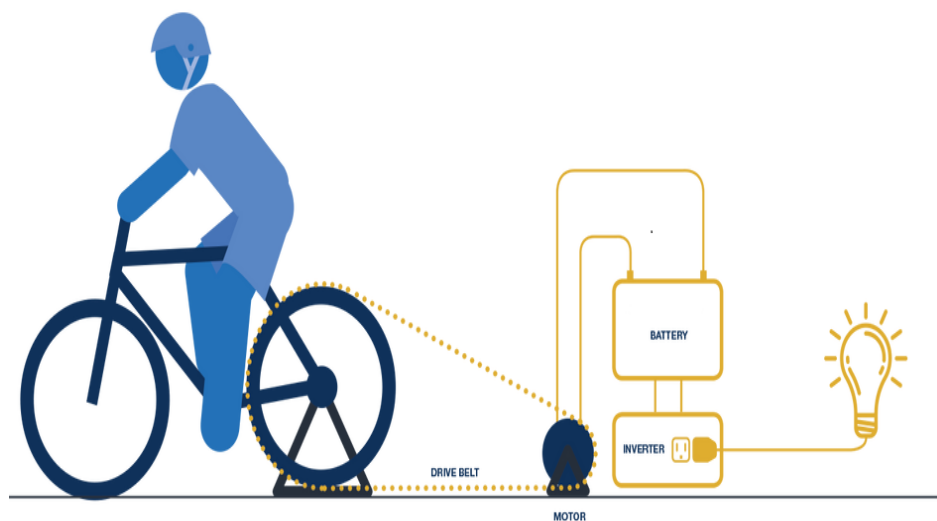


Figure 2. Working model of the proposed system

The Arduino UNO is widely regarded as the optimal board for students studying electronics and coding. The UNO board is considered to be highly resilient, making it a suitable choice for initiating one's platform experience. The Arduino UNO board is widely recognised as the most commonly used board. Relays are devices that function as electrical switches. The device is equipped with functional contact terminals and input terminals for control signals. Miniature light-detecting resistors, commonly known as photoresistors, are utilised in electronic devices. Light-dependent resistors, commonly known as LDRs, exhibit a change in their resistance when exposed to light. The resistance of the light-dependent resistor is inversely proportional to the intensity of light. This enables their utilisation in circuits designed for the detection of light. Analogue sensors are devices that quantify physical

quantities and subsequently transform them into analogue signals. When conducting measurements, digital sensors produce signals that are in a digital format. The analogue sensor is utilised to quantify environmental parameters such as wind speed, solar radiation, and light intensity, which in turn produces an analogue voltage. The voltage output exhibits a range of 0 to 5 volts. In the context of digital electronics, the binary digit "0" is commonly used to represent a logic low state, while the binary digit "1" is used to represent a logic high state. This convention typically applies when the voltage level falls within the range of 3.5 to 5 volts.

Pedal power is the process by which kinetic energy is transformed into mechanical energy through the act of a person pressing down on the pedals. Chain and pulleys are utilised for the transmission and acceleration of mechanical energy. The pulley mechanism serves as a linkage between the dynamo shaft and mechanical energy. The process by which mechanical rotation is transformed into pulsating direct electric current is accomplished through the utilisation of Faraday's law of induction, wire coils, and magnetic fields, as facilitated by the dynamo. The dynamo machine comprises of two main components, namely the stator and the armature. The stator is responsible for generating a consistent magnetic field, while the armature is a collection of windings that rotate within the magnetic field.

The motion of a wire within a magnetic field results in the induction of an electric current, which is attributed to the force exerted on the electrons of the metallic conductor. The power battery is presently undergoing charging. The process consists of a tripartite sequence of steps. At the outset, the act of pedalling serves to transform the kinetic energy generated by human exertion into mechanical energy. The rotation of the battery is a representation of this mechanical energy. Second, the Battery transforms the mechanical energy in the form of rotation into electrical energy. The battery converts electrical energy for usage later in stage three.

5. Results

The paper presents the Real Time Pedal Operated System for Battery Charging in which the battery is fully charged and utilised to power other electronics or appliances. Compared to conventional battery charging techniques, real-time pedal-operated systems have a number of benefits.



Figure 3. Proposed Pedal Operated System

They are environmentally beneficial because they don't consume fossil fuels or grid electricity. Overall, this system for battery charging system is an efficient and long-lasting way to charge batteries with human power. Building and implementing such a system could be a fulfilling the future.

6. Conclusion and Future Scope

The paper presents a real time operated system which has a lot of potential and if properly utilised the world's energy challenges would be resolved. The pedal battery charger eliminates the issue of global warming since it transforms pedal power into electric energy and provides a fix for the rising cost of power and oil. The usage of pedal power chargers for business is possible. Without using any propellant, the battery charger can be driven. This pedal-operated, real-time battery charger solves the problem for all ships, boats, and domestic and commercial appliances. Real-time data from a pedal-operated battery charger can be used for business purposes. The advantages of pedal-operated battery charging include healthy exercise and the avoidance of energy loss.

Pedal-operated battery charging devices can be employed in distant areas or places without a consistent power source, offering a sustainable and affordable way to generate electricity. Pedal-operated battery charging systems could be utilised to supply electricity for necessary equipment and communication devices in the case of a natural catastrophe or other emergency. Alternative forms of exercise that allow users to create their own electricity while staying in shape include pedal-operated battery charging systems. Bicycles and other modes of transportation could be equipped with pedal-operated battery charging devices, enabling riders to produce electricity while on the move. Students might be taught about renewable energy, sustainability, and the value of exercise using pedal-operated battery charging systems.

Declarations

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Competing Interests Statement

Authors have declared no competing interests.

Consent for Publication

The authors declare that they consented to the publication of this study.

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